

MODIS
Land Plenary Report Back
Nov 2 ,2006

Chris Justice

Recommendations in Red

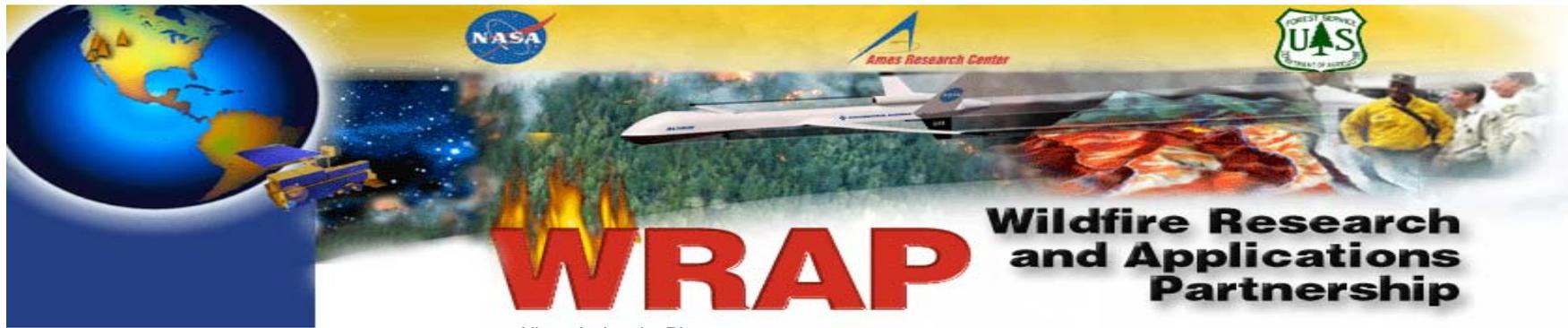
MODIS Collection 5 User Workshop

- Will provide an in-depth look at the Collection 5 changes to the MODIS Land products, MODAPS production status and reprocessing schedule and QA status.
- Will provide an opportunity for feedback from the user community on MODIS Land products and access and discussion of future land product plans.
- Will consist of presentations, tutorials and discussion.

***January 17–18, 2007 @ UMD
University College Inn and Conference Center***

Senior Review MODIS Land Issues

- Overarching statement – given the extent of climate and global change, this is not the time to reduce earth observations!
 - Int. Polar Year, CCSP goals, GCOS commitments
- Aqua/NPP overlap is a compelling argument
- Terra MODIS vs. METOP AVHRR
 - Probably the biggest threat
 - If AVHRR was good enough why did we launch MODIS in the first place
 - Generic issues of data calibration, data quality, spectral/spatial continuity
 - Science value of
 - combined AM/PM products – BRDF, LST, Fire
 - Increased cloud free observations
 - Extend the ‘science quality data record’ as long as possible
- NASA should start ingesting and processing the 1km AVHRR into the current LTDR initiatives as METOP will eventually be the am system
 - Quantify the impact of eventually moving back to METOP Am
- AN EOS Article or Special Issue should be developed from the review - on MODIS achievements and the case for not killing instruments
- Large number of applications users currently gaining direct societal benefit



Vince Ambrosia, PI

12-Channel Wildfire Scanner Specifications

- Channel 1: 0.42 - 0.45 μm
- Channel 2: 0.45 - 0.52 μm
- Channel 3: 0.52 - 0.60 μm
- Channel 4: 0.60 - 0.62 μm
- Channel 5: 0.63 - 0.69 μm
- Channel 6: 0.69 - 0.75 μm
- Channel 7: 0.76 - 0.90 μm
- Channel 8: 0.91 - 1.05 μm
- Channel 9: 1.55 - 1.75 μm
- Channel 10: 2.08 - 2.35 μm
- Channel 11: 3.60 - 3.79 μm (VIIRS M12)
- Channel 12: 10.26 - 11.26 μm (VIIRS M15)

FOV: 42.5 or 85.9 degrees (selectable)

IFOV: 1.25 mrad or 2.5 mrad (selectable)

Spatial Res.: 3 – 50 meters (altitude dependant)



General Atomics Altair UAS

Also compatible with the GA Mariner, Predator-B & Cessna Caravan C208.

- Targeting input from NIFC, MODIS Rapid Response, and GOES.
- Onboard, real-time geolocation and product generation for both imagery and fire detects.
 - Browse and fire detects available via Google Earth interface within ca. 4 minutes.
 - Cal/Val coordination with MODIS Land Team and CEOS-LPV.
- Activities in plan with AIST PIs for SensorWeb implementation in concert with MODIS.



#1
Take off
from GA /
El Mirage.

#2
Climb to
altitude using
Edwards AFB
restricted airspace.

#3
**Esperanza
Fire**
96 images collected
(including coincident
with MODIS).



At the request of California Gov. Schwarzenegger, the FAA issued an emergency COA to fly the Altair UAS with the NASA WRAP payload into civilian airspace to support the Esperanza Fire incident command.



Altair UAS Flight Line 10/28 pm & 10/29/06 am.

Esperanza Fire

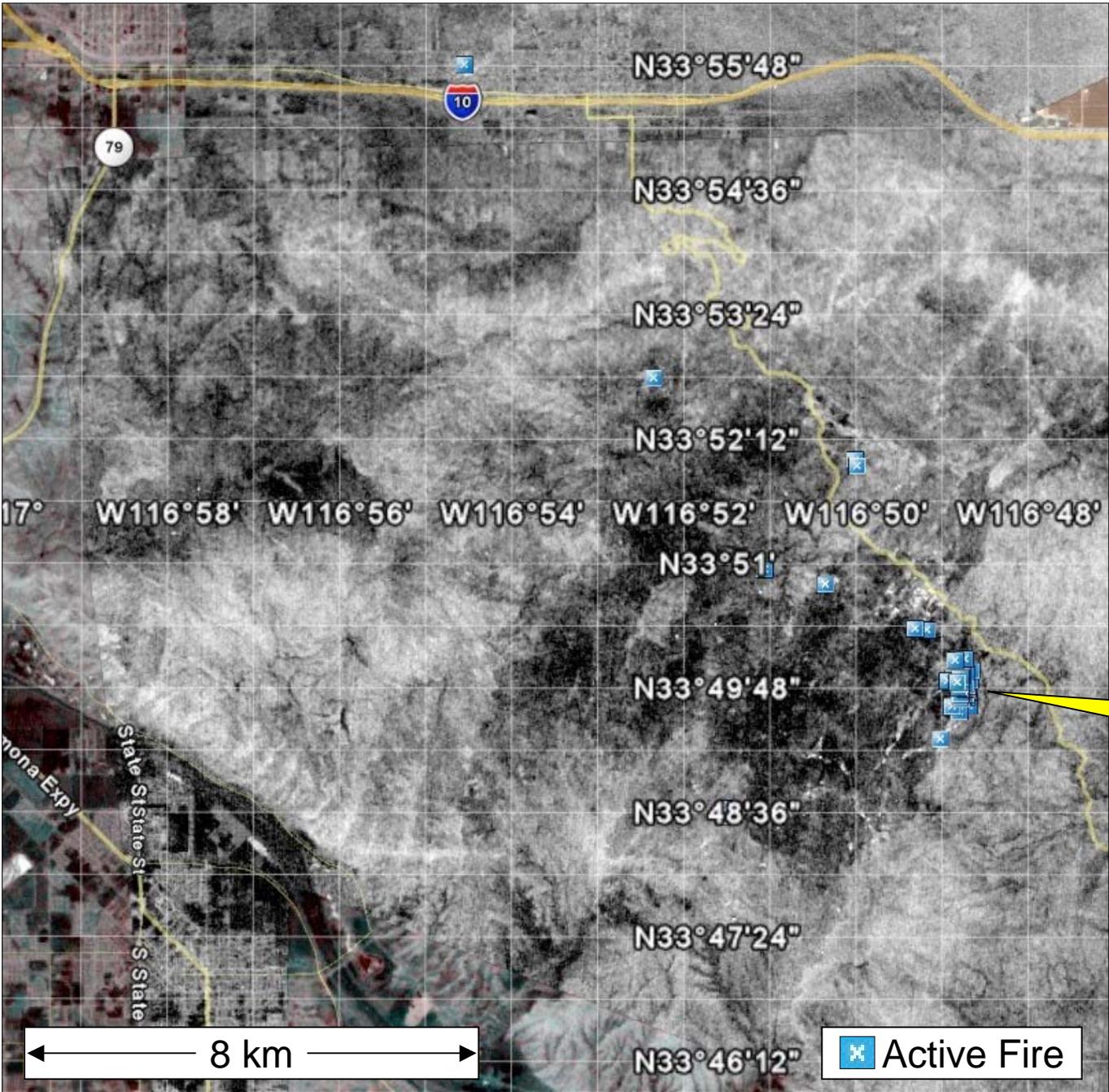
from Altair UAS carrying WRAP sensor package

10/29/06
early am

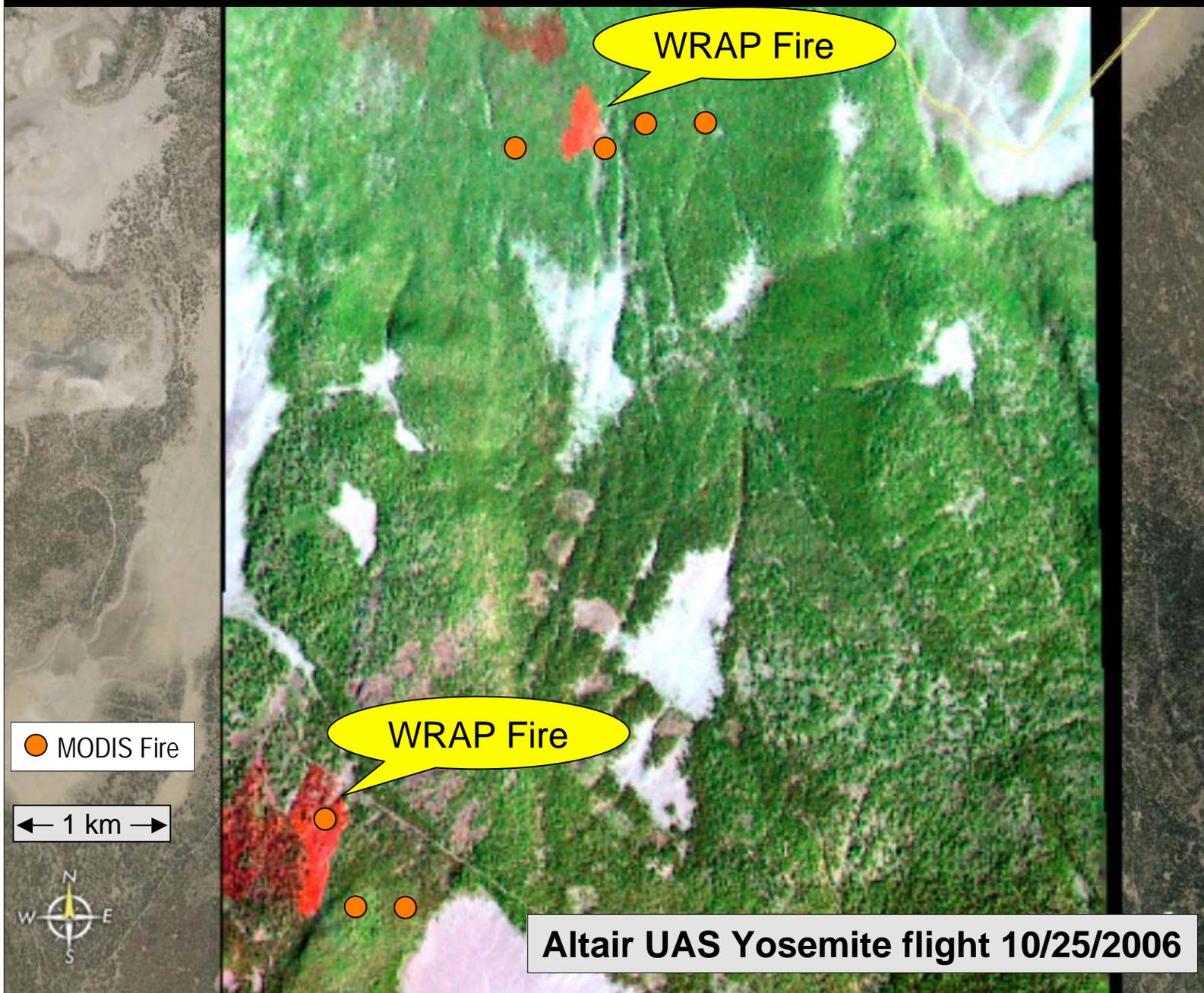
All processing on-board with distribution via satcom to incident command.

active fire front

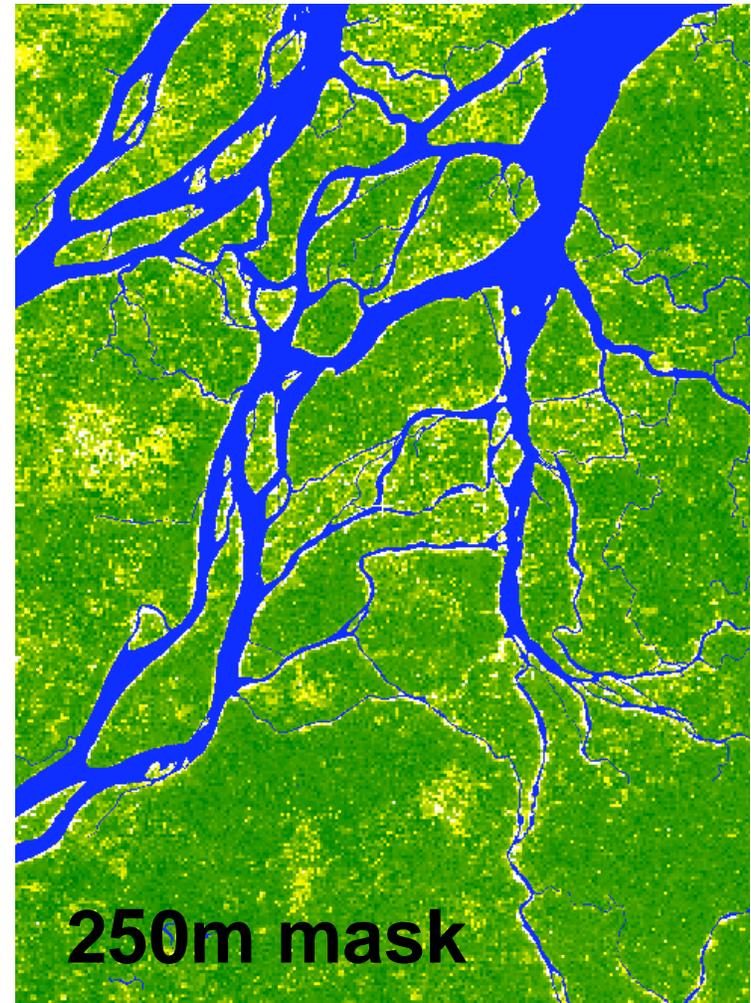
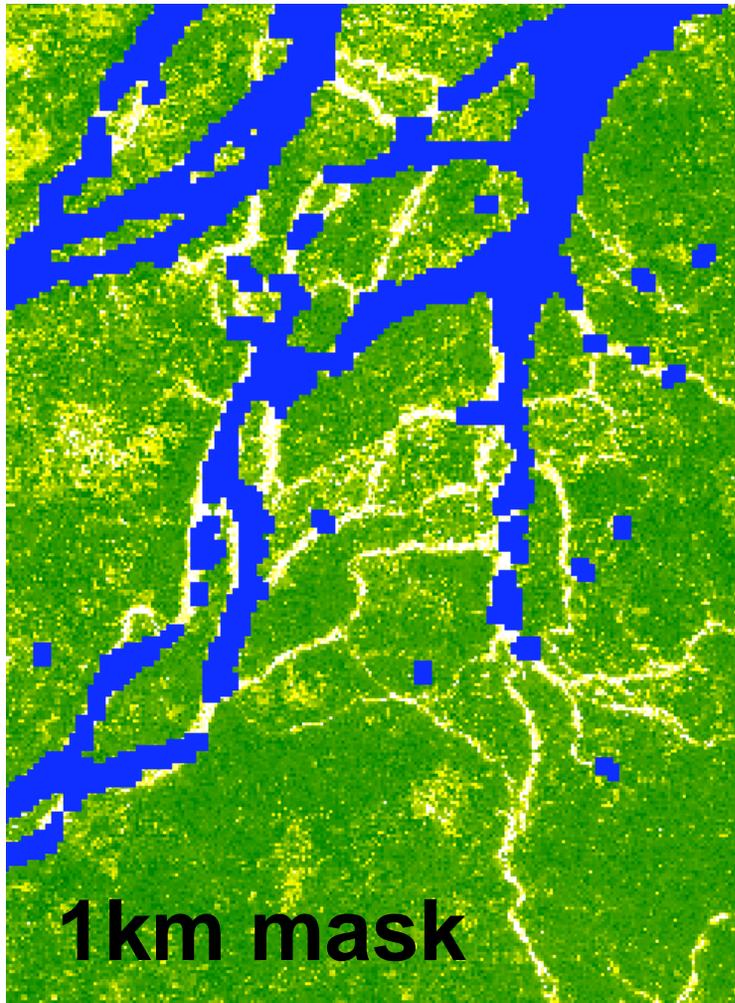
16.6 hour sustained mission.



JOINT CALVAL WITH MODIS LAND TEAM



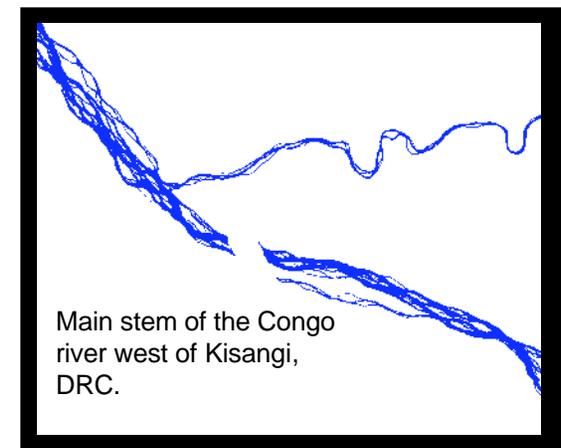
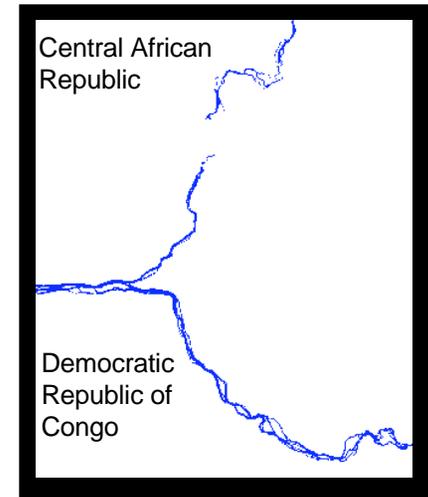
Critical Deficiencies: MODIS Land Water Mask



Visualization from the mouth of the Amazon River (MODIS tile h12v09) MODIS VCF image with water masks overlain. Left shows the currently available 1km water mask created from MODIS 1km data. Right shows the same image with the new mask using SRTM and MODIS 250m data to gap fill.

The SRTM Water Body Mask (SWBD)

- The SRTM Water Body Mask (SWBD) is now available via JPL at 90m spatial resolution
 - Represents a significant improvement on previous masks, but:
 - There are frequent gaps in the data resulting in discontinuities in major rivers
 - Only extends to 60 degrees North latitude
 - Product represents a major improvement for local studies but is unsuitable as a continental or global water mask:
 - *This product comes in 1 degree tile shape files*
 - *ESRI ARCGIS 9 cannot handle stitching together large numbers of these*
 - Shape files were generated by 2 different sub-contractors using different centroids
 - » Creates geometry problems at the intersection
 - » This is recoverable but presents an additional challenge when stitching together larger areas



Proposed New water mask from MODIS 250m data

- Proposal welcomed/endorsed by the land group
 - Integrate existing SWBD mask with 250m MODIS data to make a new water mask in raster format, at 250m resolution in MODIS tiles
 - SWBD will be gap-filled using MODIS 250m data to make rivers more continuous - gap detection and filling is automated, but will require human review to ensure complete gap coverage
 - MODIS 250m data will be used to create mask for areas north of 60°
 - Resulting data product would have 3 values: Land, Water and Shoreline
 - *Ted Scambos from NSIDC will provide Antarctic shorelines and geologically based ice shelves based on 250 m L1B*
 - *Robert Wolfe suggested updating the MODIS DEM using SRTM at the same time*
 - *An altimeter-derived topography data set for Antarctica (not SRTM) should be included*

VIIRS Land Summary Assessment - Early 07

- The VIIRS Land Group will develop a summary assessment of
 - the utility of the VIIRS EDR's for NASA Science
 - the requirements for land ESDR generation from VIIRS
 - suggested approach to EDR/ESDR validation

Mid-Decadal Global Land Survey Breakout

- Contribution to the Land Cover ESDR and GCOS
 - Broad community demand e.g. FRA 2010
- **Phase 1 Acquisition** (underway)
- **Phase 2 Orthorectification** (USGS partnership - EDC)
 - Gap-filled Landsat 7 and Landsat 5 Data
 - Multiple scenes likely needed for cloudy areas
 - Need to establish the real costs of production,
- **Phase 3 Science Products** (M-D inventory of land cover, estimate of LC change 1990/2000/2005)
- Need community guidelines on product specification and approach to implementation
 - Discussed various options – competed, peer reviewed process, consortia etc.
 - Identified need for a small LCLUC workshop (late 06/early 07) to provide product specification and guidelines

MDGLS Workshop Late 06/Early 07

- Can we prioritize the primary science questions / regional hot spots which will drive Phase 3 Implementation ?
- Can we give a set of minimum specifications for the output products ?
- How could we implement distributed product generation while maintaining product consistency and accuracy
 - Lessons learned from Landsat Pathfinder, MRLC, GLC 2000 etc
- What is a feasible and effective QA and validation approach?
- What resources would be needed to implement regional/continental products
- What prototyping R and D needs to be done in 2007

MODIS for Modelers break-out

- **Heritage**

- ISLSCP Data Initiatives – gathering of relevant data sets, GC modeler friendly
- Sellers EOS Climate Modeling Grid products (degraded resolution)

- **Current Status**

- MODIS land product dependencies BUT products developed as stand alone

- **Issues to make data more use friendly:**

- Modelers need data with no gaps in space and time
- Ensure consistencies between multiple products
- Canopy and underlying surface radiative transfer model
 - **a suite of products is needed for modelers the products are driven by the same radiation model suited for use in climate models**

MODIS for Modelers break-out

Conclusions:

- The community should adopt standard DEMs and land/sea products - using the best/most up-to-date data available (e.g. room to improve the DEMs over Greenland and Antarctica).
- MODIS LDOPE will consider methods for consistency checking between current products
- Three groups currently serving modeling community agreed to coordinate amongst themselves (C. Schaaf's work with Albedo, GSFC's ACCESS for NACP project and Forrest Hall's "Biophys") – currently prototyping data filtering
- MODIS for modelers to be presented at the Breckenridge (NCAR) annual meeting (Steve Running, Xubin to put on agenda) – to develop a community awareness of current state and future needs
- **Recommendation for a modeling product be a topic for the emerging measurement team leading to a community consensus approach driven by the modelers**

Progress on Land Measurement Team

- HQ charge: Missions > Measurements
- Developed concept at the MODIS land meetings
 - Led to ESDR White papers
 - Outreach to Water Cycle FA (Eric Wood ESDR White paper and am presentation)
- LCLUC ST Meetings focus on the Land Cover Product Suite
- Followed up at the Ecology Focus Area Workshop
 - roles organization
- ESDR's included in the ROSES call

Some of the Roles of the Measurement Teams

- Determine and respond to Focus Area observation and measurement needs
- Facilitate the shift from missions to measurements
- Develop the ESDR Requirements
 - Recognizing that these will evolve with the science
 - Recognize these may differ with different classes of users
- Provide stewardship for observations and data products
- Forum for interchange between science and applications data users and data providers
- Forum for coordination of land validation activities
- Address consistency between land products
- Interface and advocacy with NASA Management, National and International Communities

Land ESDR White Papers

http://lcluc.umd.edu/products/land_esdr/index.asp

- **Albedo (Schaaf et al)**
- **Temperature and Emissivity (Hook et al)**
- **PAR and Incident Solar Radiation (Liang et al)**
- **Snow Cover (Hall et al)**
- **Surface Reflectance (Vermote et al)**
- **Vegetation Indices (Huete et al)**
- **LAI / fPAR (Myneni et al)**
- **GPP and NPP (Running et al)**
- **ET (Wood et al)**
- **Phenology (Friedl et al)**
- *Vegetation Water Content (Ustin)- in progress*
- **Land Cover and Change (Masek et al)**
- **Fire (Justice et al)**
- *Sea Ice (Markus et al) – in progress (Which Focus Area ?)*

Building on the
White Papers
**Identify the
Top 2 Priority
Initiatives/Activities
Needed for the
Measurement
Type**

Calibrated Radiances Suite

Strawman Priority Measurement Initiatives

- **Surface Reflectance**
 - **NPP Surface Reflectance Data Continuity**
 - **NPP Aerosol over land (debugging) / Cloud Mask (refinement)**
 - **Continued Aeronet data for validation**
 - **Consistent SR products between Mod Resn (AVHRR, MODIS, VGT, MISR etc) / High Resn (Landsat, ASTER etc)**

N.B. Will need to see where Land Water Mask and DEMs fit

Radiation/Energy Budget Suite

Strawman Priority Measurement Initiatives

- **Albedo and Anisotropy**
 - Validation of global albedo products (international CEOS LPV)
 - Diurnal albedo – multisource data set (see also snow albedo)
 - Gap filled products for GCMers
- **PAR and Incident Solar Radiation**
 - Internally consistent multi-instrument global gridded PAR (initial emphasis on MODIS to increase spatial resolution (5km) and consistency between products) (assumes validation)
- **Land Surface Temperature and Emissivity**
 - Internally consistent multi-instrument global gridded LST (MODIS/ASTER/AIRS) – alg intercomparison first step
 - Internally consistent multi-instrument global gridded emissivity (MODIS/ASTER/AIRS) – alg intercomparison first step (assumes expanded cal/val activities and scaling)

N.B. Need to revisit the White paper to address diurnal cycle issue
- **Snow Cover**
 - Snow water equivalent (R and D)
 - Snow albedo validation

Vegetation Product Suite

Strawman Priority Measurement Initiatives

- **Vegetation Indices**
 - **VI Intercomparisons AVHRR, MODIS, VGT (LPV)**
 - amongst sensors and between alternative indices (e.g. NDVI/EVI)
 - **Integration of in-situ network data (validation of seasonal cycle) – see Montana**
 - **LAI / fPAR**
 - **VIIRS Continuity of MODIS LAI product**
 - **AVHRR LAI historic record**
 - **GPP and NPP**
 - **VIIRS Product Continuity**
 - **Improved daily global meteorology (accuracy)**
 - **NPP>NEE (soil respiration, and light use efficiency)**
 - **ET**
 - **Algorithm/Sensor intercomparison / consistency evaluation (GEWEX GRP Landflux?)**
 - assumes understanding of scaling and resolution
 - **Merged Approach - Global product generation / validation**
 - **Phenology**
 - **In situ network (validation/calibration) – coordination with LTER and Fluxnet and Phenology Networks**
 - **Multi instrument to overcome clouds (microwave R and D)**
- NB. (general issue of error propagation)**

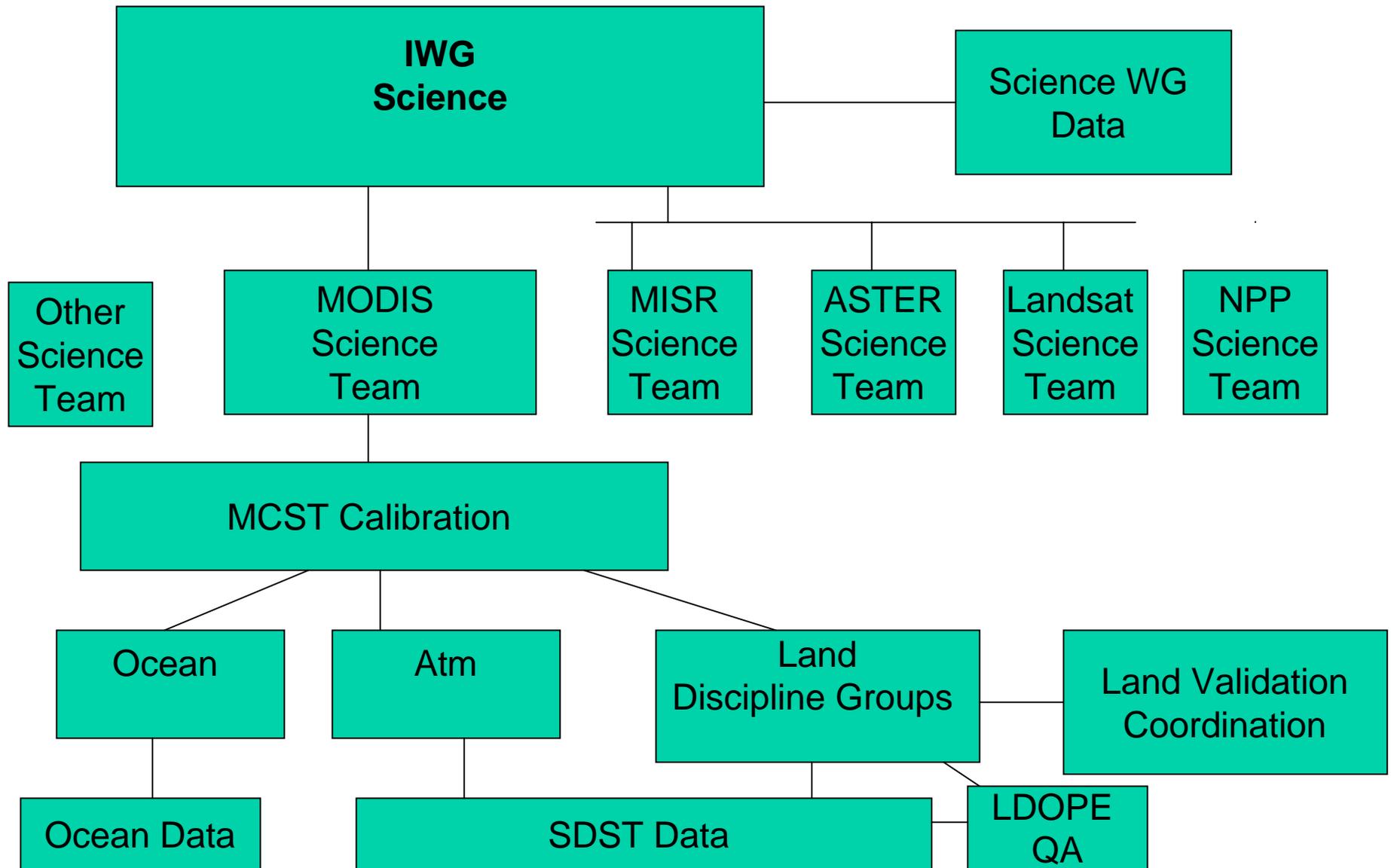
Land Cover / Change/ Disturbance Product Suite Strawman Priority Initiatives

- **Land Cover and Change**
 - **Mid Decadal GLS implementation (Phase 2/3)**
 - **LTDR AVHRR/MODIS/VIIRS consistent land cover products**
 - **Reconciliation between land cover and continuous fields**
 - **LCCS refinement leading to a Hierarchical system and augmentation for seasonal systems (wetlands and agriculture (crop type etc))**
- **Fire**
 - **Active Fire/Burned Area from VIIRS (data continuity)**
 - **Fire Radiative Power research and development and validation**
 - **Global Burned Area Validation Initiative (international - GOFC/GOLD)**

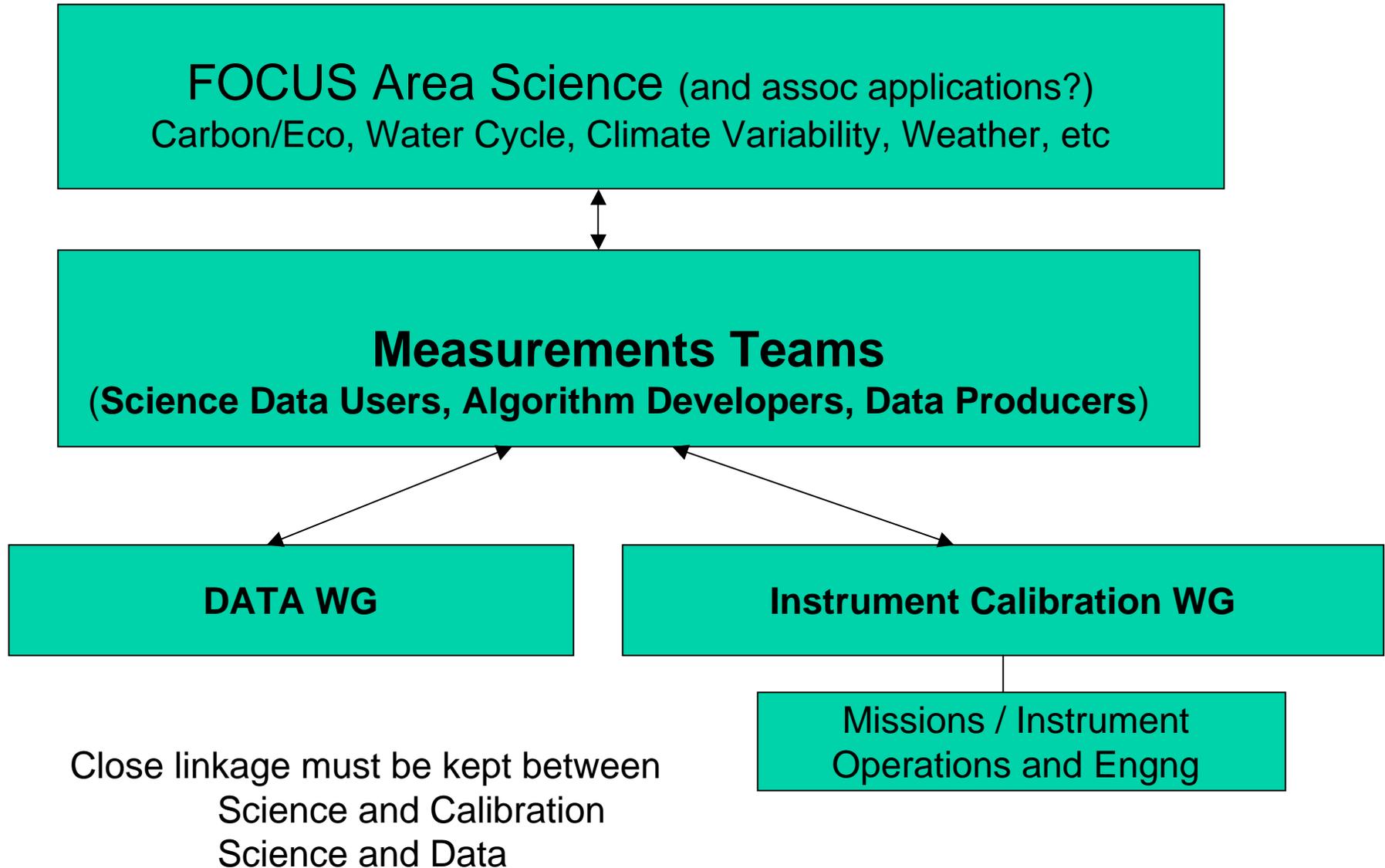
Some Common Themes

- VIIRS science land data product continuity
 - Will need a NASA land data production capability
 - Will need a coordinated validation initiative
 - Planning now but start no earlier than 1 year after launch
- Increased emphasis needed on international cooperation for data access and validation
 - Attention also to in-situ networks
 - Improved daily meteorology
- Increased emphasis on multi-instrument data fusion with attention to diurnal cycle

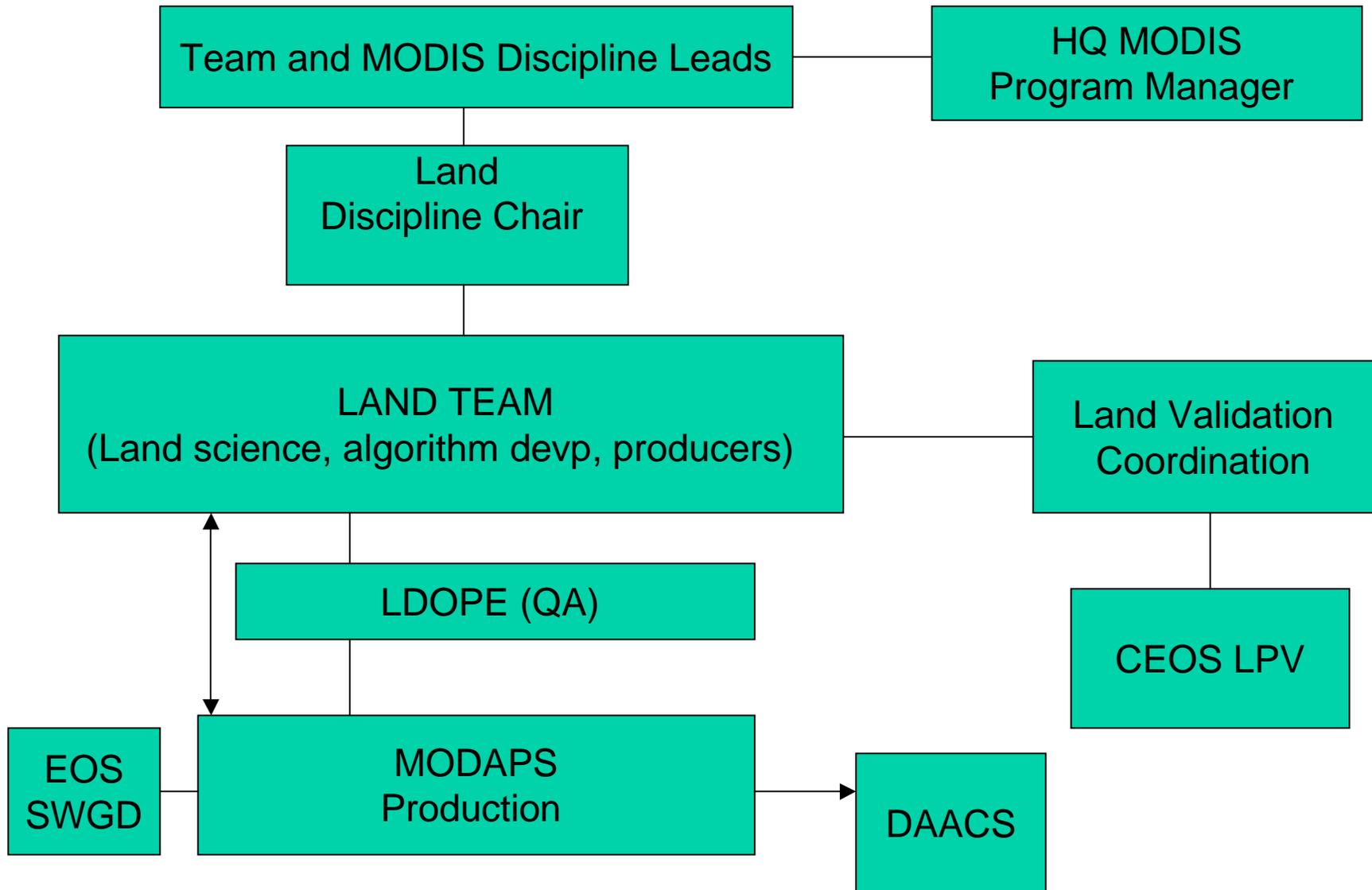
Organization: the old model?



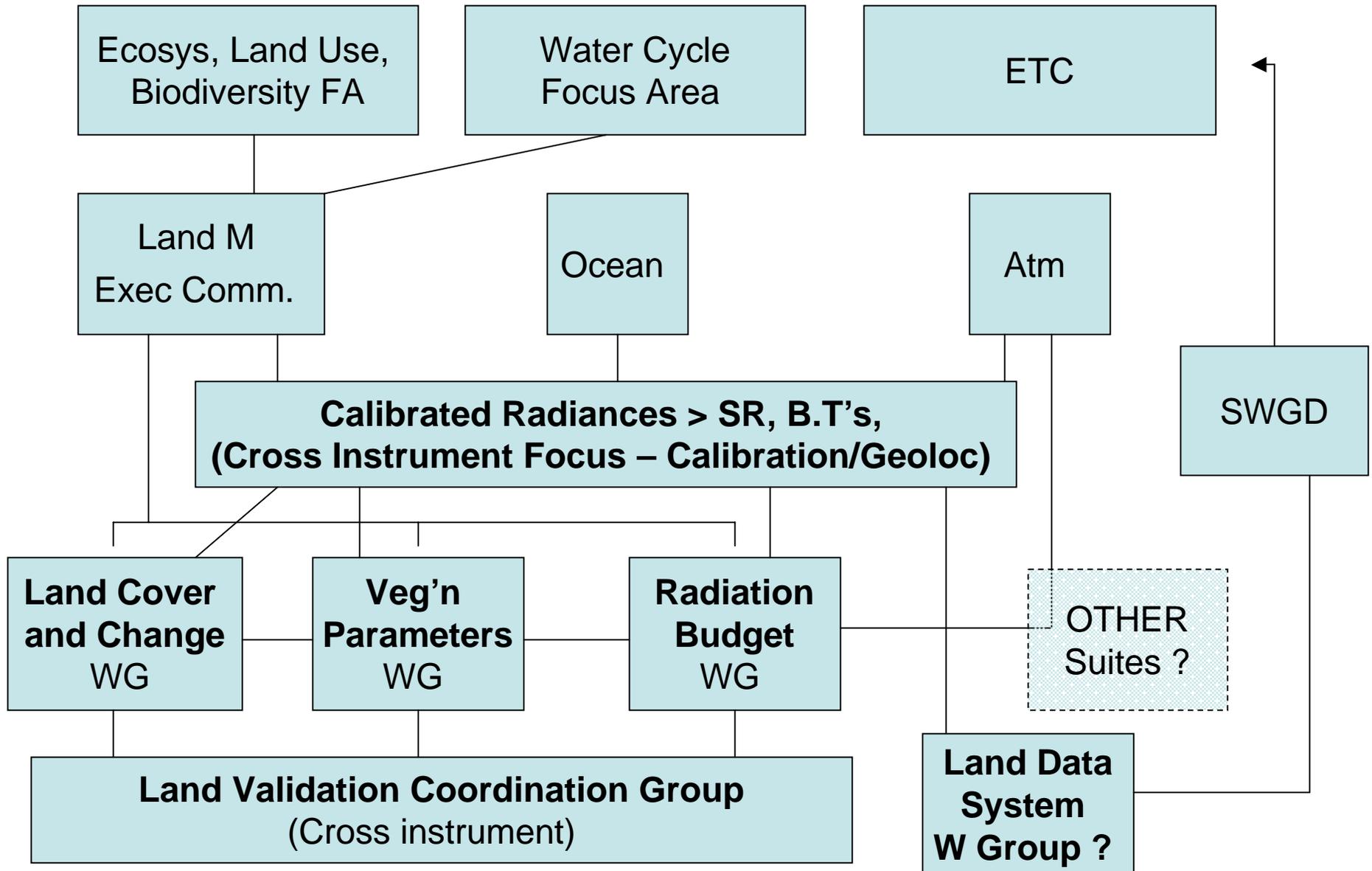
A New Model ?



Current Model for MODLand



ONE POSSIBLE NEW STRUCTURE ?



A Possible Structure

- **Land Measurement Team Chairman (funded)**
 - Leading Land Measurement Activities
 - Coordinate as needed with other FA/discipline measurement teams
 - Interface with NASA/HQ – advocacy, product reviews
 - Interface with international measurement initiatives as needed GCOS, IGOL
- **Land Measurement Group Leaders (funded)**
 - Coordinate initiatives within a sub-set of land observations
 - Coordinate as needed with other land measurement groups
- **Measurement Team Members (would meet as groups)**
 - Prioritize Measurement needs
 - Generate Measurements
 - Use Measurements
 - Composition
 - NASA Funded Investigators
 - **Obligatory membership for those generating and using products**
 - Other Concerned Agency Representatives e.g. NOAA
- **Facilities for data generation and distribution**
 - Will need close involvement of the science community
 - Efficiencies of a more centralized production capability – will help consistency issues
 - Innovation from more distributed data services and domain expertise

Competition healthy but the MT program will also need to be prescriptive – requesting and funding what is needed

Possible Land Measurement Coordination Mechanism

- Land Measurement Ex. Comm.
 - Reps from Focus Area Science sub-WGs (e.g. carbon, ecosystems, LCLUC, biodiversity) Leads ?
 - *Land Measurement Team Leader*
 - *Radiation Budget Product Suite Leader*
 - *Land Cover Change Product Suite Leader*
 - *Vegetation Product Suite Leader*
 - Land level 1b Rep
 - Land Validation Rep
 - Land Data System Group rep

*As the program develops these would be 3 yr Funded (Part Time) Positions
Might meet perhaps twice per year*

Suggestions to HQ

- Move ahead on Missions to Measurements
 - Next meeting should be after the EOS selection focused on 'Getting Organized for (multi-instrument) Measurements'
 - Initial discipline focus responsive to Focus Area Science
 - Address cross discipline coordination subsequently and through Focus Areas
- Move ahead with vegetation water content Land ATBD review
- Undertake delayed land product reviews for established products after the current recompetete